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A MODIFIED "AMES" TYPE OF SCARIFIER FOR BLACK LOCUST SEED

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The extensive planting of black locust in various parts of the country for erosion control requires the production of many millions of seedlings annually. Because a large proportion of black locust seed have impermeable seed coats which prevent or delay germination in the nursery beds, the recently increased use of this species has emphasized the importance of developing methods of seed treatment to obtain more prompt and complete germination.

Impermeability of Seed Coats. Germination and swelling tests of black locust seed collected in various parts of the Central States have revealed that from 15 to 90 per cent of the seed coats are impermeable to water, varying with different lots of seed (Table 1, Column 4). Seed which showed no swelling in water at room temperature within 10 days were considered to have impermeable seed coats, and actual seed bed tests demonstrated that there is a close relationship between swelling and germinative capacity. Impermeability was found to be due largely to suberized and cutinized secondary palisade cell walls, especially those at the outer ends of the cells adjacent to the outer or cuticularized layer. It is not definitely known why impermeability varies so widely among different lots of seed; but conditions of growth, degree of maturity of seed when gathered, methods of harvesting and storage, and inherent characters may be significant factors.

Chemical Treatment. Various chemical or soaking treatments have been suggested for reducing the impermeability of black locust seed coats, some of which have been used with considerable success. However, any chemical method involves wetting the seed and creates danger of injury to the embryos through the processes of swelling and subsequent drying, by mechanical injury from handling in a swollen or softened condition, by exposure of the embryos of seeds having naturally permeable coats, and by over-exposure of the seed to the chemical. After treatment, careful drying and storage before sowing are essential to prevent further loss.

Mechanical Treatment. In the belief that mechanical treatment of black locust seed might prove cheaper, safer, and more satisfactory in many instances where large quantities of seed are to be sown, methods of scarification of the seed coats to reduce their impermeability have been studied at the Central States Forest Experiment Station.

Use of the "barrel" type of seed scarifier has been suggested, but it does not effectively scarify lots of "hard coated" seed, and it is not adapted to rapid treatment of seed in large quantities. The various types of machines designed to scarify seed of sweet clover and other legumes were found to damage black locust seed severely through breakage, often grinding them into meal. Further tests

indicated that the "Ames" type of seed scarifier is readily adapted to modifications in design to permit of its use for effective and economical treatment of black locust seed. The work that has been done to date and the results achieved are explained herein for the benefit of nurserymen who need this or similar equipment immediately. Further experimentation will undoubtedly lead to an even more efficient scarifying machine.

The "Ames" Scarifier. The Ames hulling and scarifying machine was developed about 1913 by Professor H. D. Hughes of the Farm Crops Department, Iowa State College, Ames, Iowa, for use on sweet clover seed. Its principle is simple and has been used as the basis for other types of scarifying machines. Before any changes were made, the "Ames" scarifier damaged black locust seed severely through breakage, but its simple construction permitted of modifications to correct this and other difficulties (Figure 1). The principal changes were a control of the fan speed; a closing of the side fan-openings with screen to prevent loss of seed; a reduction of the cross-section of the seed race (originally 2 inches by 10 inches) to approach more nearly that of the blower pipe; and the covering of both broad inner faces of the race with an abrasive.

A "forge blower" with a 12-inch fan is mounted on a platform near an A. C., single phase, one horse-power, electric motor with a 1750 R.P.M. for currents of 110-220 volts. Both the motor and fan are equipped with a set of "three-speed intermediate pulleys" arranged for varying the fan speed with one length of belt (Figure 1-C). The fan originally had four blades; but at the time of purchase, it was equipped with four additional blades. To the end of each, a broader blade of heavy galvanized sheeting with forward projecting flanges had been riveted. A 2-inch rim of the same metal had been cut and riveted to these flanges on either side of the fan. This made it possible to add the four extra blades (short ones), one midway between two original blades, to produce a greater air current and to give a more uniform blasting of seed against the abrasive surfaces of the race (Figure 1-B). The blower fan rotates in a cast iron housing which has a 4-inch opening on either side. With the exception of a small space for the seed spout, these openings were closed by fastening galvanized hardware cloth over them with screws to prevent loss of seed flung by the fan. A semi-circular tight race with an inner cross-section of 2 inches by $5\frac{1}{2}$ inches is attached at the lower end to the blower. Before the reduction in the cross-section had been made, the air current was insufficient to carry the heavy black locust seed through the machine. Both of the broad inner faces of the race are surfaced with strips of #3 or $\#3\frac{1}{2}$ Garnet Paper. This paper, 6 or 8 inches wide, may be purchased in rolls. By surfacing both of the broad inner faces of the seed race, scarification was considerably increased. Directly above the blower is a hopper from which seed is fed into the race through the fan at a rate controlled by a slide. The seed is scarified by being blasted against the curved surfaces of the race by the fan blades and the air current and is carried into a hopper at the rear of the machine from which it can be sacked.

Seed pass through a series of baffle plates at the end of the race before entering the second hopper. The plates are designed to clean the seed of light chaff which passes out of the machine with the air current while the heavier seed are checked and drop into the hopper. However, most seed now on the market are well cleaned.

The speed of the fan, controlled by the pulleys used, should be varied between 1700 and 2200 R.P.M. for different lots of seed. Usually, the larger the

seed, the greater are the ease of scarifying and the damage through breakage. Also, seed coats vary widely in their brittleness. The optimum speed may be determined on 1/4 pound of seed. This speed is the maximum which the coats can withstand with a minimum of breakage. Exceptionally tough coated seed will require the maximum speed and may withstand a second treatment if necessary. Breakage is easily held to less than 2 per cent by proper control of the fan speed.

The cost of the machine is relatively low. Although the Ames scarifier is no longer on the market, used outfits (for remodeling), excluding the motor, may be purchased for fifteen to twenty-five dollars from county Farm Bureau agencies, High School departments of agriculture, or from other agencies or individuals who have discarded them for more modern equipment; or one may be easily constructed. Costs involve those for new or used forge blower and electric motor, lumber for frame work, 28-gauge or heavier galvanized sheeting for hoppers and seed race, and Garnet Paper. When this investment is pro-rated over a period of years, and when large quantities of locust seed are treated, the cost of scarification is low.

The rate at which seed can be scarified with this machine encourages more general treatment of seed in one-half ton or greater lots prior to sowing. Although size of seed and brittleness of seed coats may vary the rate somewhat, a bushel of seed can be scarified in approximately 5 minutes.

Results of Scarification. Tests on numerous lots of seed have shown that the percentage of germination of scarified seed is appreciably increased. The table below gives the per cent of swelling (approximate germinative capacity) for each of 10 lots of untreated and scarified seed. Samples of 250 seed of each were soaked in water for a period of 10 days. The treated seed was scarified at a fan speed of 2000 R.P.M.

Table 1

Seed Source	Seed per pound	Loss by breakage at 2000 R.P.M.	Swelling Test		Increase in swelling due to Scarification
			Untreated Seed	Whole Scarified Seed	
	Number	Approximate Per cent	Per cent	Per cent	Per cent
1. Aurora, Ind.	24,480	0.1	11.5	89.0	77.1
2. Hillsboro, Ohio	16,329	5.0	87.4	99.2	11.8
3. Butler, Ohio	28,896	1.5	31.3	93.1	61.8
4. Minerva, Ohio	23,274	3.0	21.8	95.0	73.2
5. Milton, Ky.	26,284	1.5	47.8	97.1	49.3
6. Peekskill, N. Y.	20,160	3.0	24.0	98.1	74.1
7. Elizabethtown, Ill.	24,210	0.5	25.0	94.3	69.3
8. Southern Europe	21,420	0.5	50.6	91.2	40.6
9. Cottage Grove, Tenn.	18,450	2.5	32.4	90.7	58.3
10. Unknown (Katzenstein)	24,570	0.1	39.3	95.0	55.7

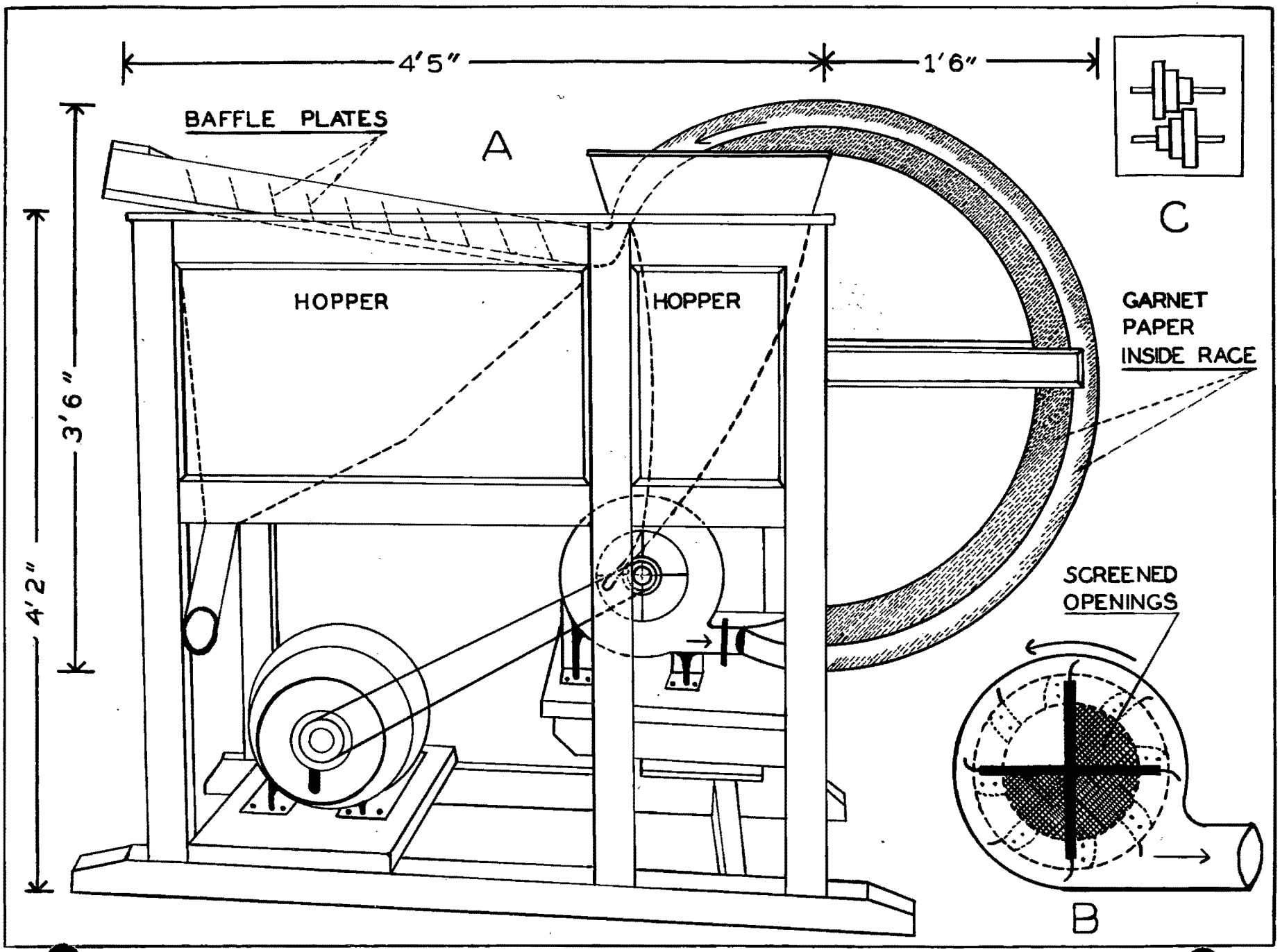
4'5"
1'6"
BAFFLE PLATES
A
C
HOPPER
HOPPER
GARNET
PAPER
INSIDE RACE
3'6"
4'2"
SCREENED
OPENINGS
B

FIGURE 1